

## PHY820 Homework Set 5

1. [5 pts] Goldstein, Problem 2.2. Use the Noether's theorem and consider invariance under the transformation  $\vec{r}_i \rightarrow \vec{r}'_i = \vec{r}_i + \epsilon \vec{n} \times \vec{r}_i$ , where  $\vec{n}$  is the direction vector for the axis of rotation and  $\epsilon$  is an infinitesimally small angle of rotation. First show that the component of angular momentum  $\vec{n} \cdot \vec{L}$  is conserved under that invariance in the case of  $L = T - V$ . In SI units, the generalized electromagnetic potential for particle  $i$  is  $U_i = q_i \Phi_i - q_i \vec{v}_i \cdot \vec{A}_i$ .
2. [10 pts] Goldstein, Problem 2-14.
3. [10 pts] A ladder of length  $L$  and mass  $M$  rests against a smooth wall and slides without friction on the wall and the floor. Assume that the ladder is initially at rest at an angle  $\alpha_0$  with respect to the floor. Use the method of Lagrange undetermined multipliers to find the angle  $\alpha_1$  at which the ladder leaves the wall.
4. [5 pts] By considering the respective Lagrangian, determine the integrals of motion for a particle moving in a uniform field  $V = -\vec{F} \cdot \vec{r}$ .
5. [10 pts] Goldstein, Problem 2-21.